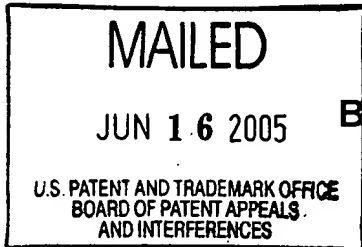


The opinion in support of the decision being entered today was not written for publication and is not binding precedent of the Board.

UNITED STATES PATENT AND TRADEMARK OFFICE



**BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES**

Ex parte GUANGCAI XING, GARY E. MINER, DAVID R. LOPES,
SITA R. KALURI and RICHARD N. TAUBER

Appeal No. 2005-1113
Application No. 09/298,064

ON BRIEF

Before PAK, OWENS, and WALTZ, Administrative Patent Judges.
PAK, Administrative Patent Judge.

DECISION ON APPEAL

This is a decision on an appeal under 35 U.S.C. § 134 from the examiner's refusal to allow claims 1 through 7, 17, 18 and 20, which are all of the claims pending in the above-identified application.

According to appellants (Brief, page 3), the claims on appeal are grouped as follows:

Group I - Claims 1-4;
Group II - Claim 5;
Group III - Claims 6-7;

Group IV - Claims 17-18; and
Group V - Claim 20

Therefore, for purposes of this appeal, we select claims 1, 5, 6, 17 and 20 as representative of the above groups of the claims on appeal and determine the propriety of the examiner's rejections set forth below based on these representative claims in accordance with 37 CFR § 1.192(c)(7)(2003) and 37 CFR § 41.37(c)(1)(vii)(2004). Claims 1, 5, 6, 17 and 20 are reproduced below:

1. An apparatus comprising:
 - a first reaction chamber;
 - a gas source coupled to the first reaction chamber to supply a nitrogen gas to the first reaction chamber;
 - an excitation energy source coupled to the first reaction chamber to generate a nitrogen plasma comprising nitrogen ions and radicals from the nitrogen gas; and
 - a second reaction chamber adapted to house a substrate for film formation at a site in the second reaction chamber,wherein the first reaction chamber is coupled to the second reaction chamber and separated from the substrate site by a distance equivalent to the lifetime of the nitrogen ions at a plasma generation rate such that the radicals react with substrate in a film conversion step.
5. The apparatus of claim 1, wherein the second reaction chamber is a rapid thermal processing chamber.
6. An apparatus for exposing a substrate to plasma, comprising:
 - a first reaction chamber;
 - means for supplying a nitrogen gas to the first reaction chamber;

means for generating a plasma from the nitrogen gas, the plasma comprising ions and radicals;

a second reaction chamber having means for housing a substrate for film formation processing; and

means for providing the plasma to the second chamber substantially free of nitrogen ions such that the nitrogen radicals react with a substrate in a process conversion step.

17. A system for reacting a plasma with a substrate, comprising:

a first chamber;

a nitrogen gas source coupled to the first chamber comprising constituents adapted to react with a substrate;

an energy source coupled to the first chamber;

a second chamber configured to house a substrate for film formation processing;

a system controller configured to control the introduction of a nitrogen gas from the nitrogen gas source into the first chamber and to control the introduction of an energy from the energy source; and

a memory coupled to the controller comprising a computer-readable medium having a computer-readable program embodied therein for directing operation of the system, the computer-readable program comprising:

instructions for controlling the nitrogen gas source and the energy source to convert a portion of a nitrogen gas supplied by the gas source into a plasma comprising nitrogen ions and radicals,

wherein the first reaction chamber is separated from the second reaction chamber by a distance equivalent to the lifetime of the nitrogen ions at a plasma generation rate such that the radicals react with a substrate in the a second chamber in a film conversion step.

20. A machine readable storage medium containing executable program instructions which when executed cause a digital processing system to perform a method of reacting a plasma with a substrate, comprising:

generating a plasma from nitrogen comprising radicals and nitrogen ions in a first chamber;

and

transferring the plasma radicals via a distance equivalent to the lifetime of the nitrogen ions into a second chamber substantially free of ions.

The prior art references relied upon by the examiner are:

Moslehi	5,082,517	Jan. 21, 1992
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Yamazaki	6,130,118	Oct. 10, 2000 (Filed Mar. 3, 1997)
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Matsuo et al. (Matsuo), *J. Vac. Sci. Technol. A*, Vol. 15, No. 4, "Role of N₂ addition on CF₄/O₂ remote plasma chemical dry etching of polycrystalline silicon," American Vacuum Society (Jul/Aug 1997), pp. 1801-1813.

The literature evidence relied upon by the appellants is:

Wolf et al. (Wolf), *Silicon Processing for the VLSI ERA*, Vol. 1: Process Technology, 1986, PP 547-551.

The appealed claims stand rejected as follows:

- 1) Claims 1 through 4, 6 and 7 under 35 U.S.C. § 102(b) as anticipated by, or in the alternative, under 35 U.S.C. § 103 as unpatentable over the disclosure of Matsuo;
- 2) Claim 5 under 35 U.S.C. § 103 as unpatentable over the combined disclosures of Matsuo and Yamazaki; and

- 3) Claims 17, 18 and 20 under 35 U.S.C. § 102(b) as anticipated by the disclosure of Moslehi.

We have carefully considered the appellants' arguments, but we are not persuaded of reversible error in any of the examiner's rejections relating to claims 1 through 7, 17 and 18. However, we are persuaded that substantial evidence does not support the examiner's § 102(b) rejection of claim 20. Accordingly, we only affirm the examiner's decision rejecting claims 1 through 7, 17 and 18. Our reasons for these determinations follow.

Matsuo illustrates an apparatus for plasma chemical dry etching a polycrystalline silicon on a wafer, wherein a tubing/lining is coupled to a processing chamber having an ellipsometer and an E/S chuck. See page 1802, Figure 1. CF₄, O₂ and N₂ are delivered to an upper portion of the tubing/lining from gas cylinders designated as CF₄, O₂ and N₂. *Id.* The flow rates of CF₄, O₂ and N₂ are adjusted by "Mass Flow Controllers" and "Regulators". *Id.* At the upper portion of the tubing/lining a plasma is produced via a microwave plasma applicator. See page 1802. "The plasma is separated from the processing chamber by [downstream] tubing of variable length and lining material. For the current work, these lining materials were quartz and Teflon and the lengths varied from 0 to 125 cm." *Id.* The wafer having a polycrystalline silicon material is placed on the chuck located in the processing chamber during the etching experiments. *Id.*

The examiner finds that 1) the upper portion of the tubing/lining shown in Matsuo corresponds the claimed “first reaction chamber”; 2) the gas cylinders attached to the upper portion of the tubing/lining via a conduit as shown in Matsuo correspond to the claimed “gas source coupled to the first reaction chamber...”; 3) the microwave plasma applicator shown and taught by Matsuo corresponds to the claimed “excitation energy source coupled to the first reaction chamber to generate a nitrogen plasma...”; 4) the processing chamber having a wafer shown and taught by Matsuo corresponds to the claimed “second reaction chamber adapted to house a substrate for film formation...”; and 5) the distance extending from the upper portion of the tubing/lining to the chuck in the processing chamber shown and taught by Matsuo corresponds to the claimed “distance equivalent to the lifetime of the nitrogen ions at a plasma generation rate such that the radicals react with the substrate in [the second reaction chamber during] a film conversion step.” Compare the final Office action dated July 29, 2003, pages 2-4, and the Answer, pages 3-6, with claim 1 on appeal.

The appellants argue that Matsuo does not describe a “second reaction chamber adapted to house a substrate for film formation...[since] Matsuo describes only etching of silicon.”¹ See the Brief, pages 4 and 5 and the Reply Brief, pages 2-3. In other words, the appellants argue that Matsuo is silent with respect to the claimed functional limitation relating to film formation.

¹The appellants refer to Wolf to show how a CF₄ plasma etching of silicon is accomplished.

Although the appellants are free to recite features of an apparatus either structurally or functionally, choosing to define such features functionally has some risk. See *In re Schreiber*, 128 F.3d 1473, 1477, 44 USPQ2d 1429, 1432 (Fed. Cir. 1997); *In re Swinehart*, 439 F.2d 210, 212, 169 USPQ 226, 228 (CCPA 1971). As our reviewing court stated in *Schreiber*, 128 F.3d at 1478, 44 USPQ2d at 1432:

Where the Patent Office has reason to believe that a functional limitation asserted to be critical for establishing novelty in the claimed subject matter may, in fact, be an inherent characteristic of the prior art, it possesses the authority to require the applicant to prove that the subject matter shown to be in the prior art does not possess the characteristic relied on.

Here, the examiner has reason to believe that the functional limitation in question is an inherent characteristic of the processing chamber taught by Matsuo. Indeed, substantial evidence supports the examiner's finding at page 4 of the Answer that Matsuo teaches a processing chamber capable of housing a substrate for film formation.² See Matsuo, page 1805. Yet, the appellants have not demonstrated that Matsuo's processing chamber does not possess structures to carry out the claimed function in question. The appellants can only refer to process (etching) conditions (rather than structure features) as the only difference between the claimed second reaction chamber and Matsuo's processing chamber. See, e.g., the Brief, pages 4-6 and the Reply Brief, page 3. Thus, on this record, the appellants have not shown that the claimed second reaction chamber is

² It is also well known that a plasma-assisted wafer processing chamber, such as that shown by Matsuo, is used to deposit a thin film or etch a thin film. See, e.g., Moslehi, column 1, lines 16-28.

structurally different from Matsuo's silicon wafer processing chamber. *In re Casey*, 370 F.2d 576, 580, 152 USPQ 235, 238 (CCPA 1967); *In re Otto*, 312 F.2d 937, 939, 136 USPQ 458, 459 (CCPA 1963); *Ex parte Masham*, 2 USPQ2d 1647, 1648 (Bd. Pat. App. & Int. 1987).

The appellants argue that Matsuo does not teach or suggest that the first reaction chamber coupled to the second reaction chamber is "separated by a distance equivalent to the lifetime of nitrogen ions at a plasma generation rate...." See the Brief, page 5 and the Reply Brief, pages 2-3. We disagree.

As properly found by the examiner (Answer, pages 5-6), the length of the tubing/liner defined by Matsuo is encompassed by the claimed functionally defined distance. This is especially true since according to page 17 of the specification, the claimed functionally defined distance can be varied based on, *inter alia*, a flow rate of a processed gas. In other words, the claimed functionally defined distances embrace any and all distances so long as such distances can provide the claimed function at one of any chosen flow rates of processed gases. It follows that substantial evidence supports the examiner's finding that the length of Matsuo's tubing/liner (distance) is capable of performing the claimed function in question. On this record, the appellants have not demonstrated to the contrary. In other words, the appellants have not evinced that the length of Matsuo's tubing/liner is structurally different from that claimed. *Casey*, 370 F.2d

at 580, 152 USPQ at 238; *Otto*, 312 F.2d at 939, 136 USPQ at 459; *Masham*, 2 USPQ2d at 1648.

With respect to claims 6 and 7, the appellants argue that Matsuo does not teach “a second reaction chamber having means for housing a substrate for film formation processing” and “means for providing the plasma to the second reaction chamber substantially free of nitrogen ions such that the nitrogen radicals react with a substrate in a process conversion step.” See the Brief, page 8 and the Reply Brief, page 4. However, the appellants do not indicate what structures described in the specification correspond to the claimed means-plus-function limitations.^{3,4} In fact, the appellants do not dispute the examiner’s finding that Matsuo teaches structures which are either identical or equivalent to those structures corresponding to the claimed means-plus-function limitations. Compare the Answer, pages 7-10 with the Brief, page 8 and the Reply Brief, page 4. Rather than arguing the structural differences between the claimed and the prior art apparatuses, the appellants again argue the differences in the intended uses. See, e.g.,

³ *In re Donaldson*, 16 F.3d 1189, 1193, 29 USPQ2d 1845, 1848 (Fed. Cir., 1994)(*in banc*)(When the limitations recited in claims are defined in a means-plus-function format, they are interpreted as corresponding to the structures described in the specification or equivalents thereof pursuant to 35 U.S.C. 112, paragraph 6.).

⁴ *Atmel Corp. v. Information Storage Device, Inc.*, 198 F.3d 1374, 1382, 53 USPQ2d 1225, 1230 (Fed. Cir. 1999)(“[T]he corresponding structure(s) of a means-plus-function limitation must be disclosed in the written description in such a manner that one skilled in the art will know and understand what structure corresponds to the means limitation. Otherwise, one does not know what the claim means.”)

the Reply brief, page 4. For the reasons set forth above, we are again not persuaded by this argument.

With respect to claim 5, the appellants argue that there is no suggestion or motivation to combine the teachings of Matsuo and Yamazaki. See the Brief, page 7 and the Reply Brief, pages 3-4. We do not agree.

As is apparent from the discussion above, Matsuo teaches a plasma reaction apparatus where silicon wafers are subjected to a plasma chemical etching. Matsuo does not indicate whether or not its plasma reaction apparatus can be used for other purposes. However, we find that Yamazaki is generally directed to a plasma reaction apparatus, which is inclusive of the plasma reaction apparatus of the type described in Matsuo.⁵ See column 1, lines 10-15. We find that Yamazaki teaches that its plasma reaction apparatus can be used for depositing films on silicon wafers effectively, especially if a rapid thermal processing chamber is provided. See column 1, lines 10-15 and column 6, lines 1-22. Thus, we determine that one of ordinary skill in the art would have been led to provide a rapid heating means in the processing chamber of Matsuo (modify Matsuo's processing chamber to make a rapid thermal processing chamber), motivated by a reasonable expectation of carrying out both etching and deposition of films on silicon wafers

⁵ It is also well known that a plasma reaction apparatus can be used for depositing, etching, surface cleaning and annealing during the manufacture of semiconductors. See, e.g., Moslehi, column 1.

effectively. This is especially true in this situation since Matsuo requires heating means even during the etching of films on silicon wafers. See page 1802.

With respect to claims 17 and 18, the appellants only argue that Moslehi “does not describe a system including a first reaction chamber and a second reaction chamber that are separated by a distance equivalent to the lifetime of nitrogen ions at a plasma generation rate such that radicals react with a substrate in the second chamber in a film conversion step.” See the Brief, page 5. We do not agree.

As indicated *supra*, the appellants acknowledge at page 17 of the specification that the claimed functionally defined distance can be varied based on, *inter alia*, a flow rate of a processed gas. In other words, the claimed distance can embrace any and all distances so long as such distances can provide the claimed function at one of any chosen flow rates of processed gases. On this record, we concur with the examiner that the claimed distance between the first and second reaction chambers do not exclude the distance described in Moslehi.

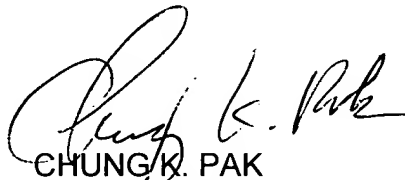
With respect to claim 20, the appellants argue that Moslehi “does not describe a machine-readable storage medium containing program instructions including transferring a plasma radicals of nitrogen via a distance equivalent to the lifetime of nitrogen ions into a chamber substantially free of ion.” See the Brief, page 9. As Moslehi is directed to “introducing both charged and neutral species to a process chamber,” we concur with the appellants that Moslehi’s machine-readable storage medium does not contain the claimed

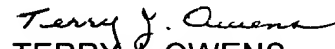
program instructions within the meaning of 35 U.S.C. § 102(b). See, e.g. the Brief, page 9.

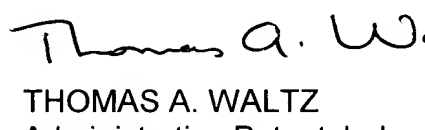
For the factual findings set forth in the final Office action dated July 29, 2003, the Answer and above, we affirm the examiner's decision rejecting claims 1 through 7, 17 and 18 under Sections 102(b) and/or 103. However, we reverse the examiner's decision rejecting claim 20 under Section 102(b) for the reasons set forth above and in the Brief.

No time period for taking any subsequent action in connection with this appeal may be extended under 37 CFR § 1.136(a).

AFFIRMED-IN-PART


CHUNG K. PAK
Administrative Patent Judge


TERRY J. OWENS
Administrative Patent Judge


THOMAS A. WALTZ
Administrative Patent Judge

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